CLAIMS

1. A phosphor for converting ultraviolet light or blue light emitted from a light emitting element into a visible white radiation having a very high level of color rendering properties, said phosphor being characterized by comprising a light emitting component prepared from a solid system of an alkaline earth metal antimonate and a system derived from the solid system exhibiting intrinsic photoemission, such as a fluoroantimonate, a light emitting component prepared from a manganese(IV)-activated antimonate, a titanate, silicate-germanate, and an aluminate, a light emitting component prepared from a europium-activated silicate-germanate or from a system containing a sensitizer selected from a group consisting of Eu(II) and Mn(II) as a secondary activator and having an orange color, an orange-red color, a red color, or a dark red color in the spectrum range over 600 nm, or a light emitting component composed of a mixture of eight or less light emitting components having different emission bands and brought to a state of broad continuous emission of about 380 to 780 nm having a color temperature of about 10,000 K with blue-white color to 6,500 K with daylight color and a color temperature of about 3,000 K with warm white color to 2,000 K with twilight color of reddish yellow by virtue of the superposition of the emission bands.

2. A phosphor for converting ultraviolet or blue light

emitted from the light emitting element according to claim 1 to a visible white radiation having a very high level of color rendering properties, characterized by comprising a light emitting alkaline earth metal antimonate represented by general formula

$$Me^{I}_{x}Me^{II}_{y}Sb_{a}O_{b}X_{c}$$

wherein

Me^{I} is at least one element selected from the group consisting of calcium (Ca), strontium (Sr), barium (Ba), cadmium (Cd), zinc (Zn), beryllium (Be), magnesium (Mg), europium (Eu), manganese (Mn), scandium (Sc), yttrium (Y), lanthanum (La), samarium (Sm), praseodymium (Pr), dysprosium (Dy), and terbium (Tb),

Me^{II} is at least one element selected from the group consisting of lithium (Li), sodium (Na), potassium (K), rubidium (Rb), and cesium (Cs),

X (uppercase letter) represents at least one element selected from the group consisting of fluorine (F), chlorine (Cl), and bromine (Br),

x (lowercase letter) = 0 (zero) to 8,

$y = 0$ to 4,

$0 < a < 16$,

$0 < b < 64$,

$0 \leq c \leq 4$,

and a part of antimony (Sb) may be replaced with vanadium (V), niobium (Nb), tantalum (Ta), phosphorus (P), arsenic (As), titanium (Ti), zirconium (Zr), hafnium (Hf), silicon (Si), germanium (Ge), molybdenum (Mo), or tungsten (W), or

alternatively may contain a system derived from them, for example, a fluoroantimonate.

3. A phosphor for converting ultraviolet or blue light emitted from the light emitting element according to claim 1 or 2 to a visible white radiation having a very high level of color rendering properties, characterized by comprising an alkaline earth metal antimonate which exhibits intrinsic photoemission and emits light in a red spectrum region with a maximum emission wavelength of about 600 to 670 nm.

4. A phosphor for converting ultraviolet or blue light emitted from the light emitting element according to claim 1 or 2 to a visible white radiation having a very high level of color rendering properties, characterized by comprising a light emitting manganese(IV)-activated antimonate which exhibits an emission band in a deep red spectrum region with about 600 to 700 nm or a narrow structured light emission with about 650 to 660 nm.

5. A phosphor for converting ultraviolet or blue light emitted from the light emitting element according to claim 1 to a visible white radiation having a very high level of color rendering properties, characterized by comprising a manganese(IV)-activated titanate represented by general formula

$$Me^{I}_{x}Me^{II}_{y}Ti_{1-a}O_{4}X_{m}:Mn_{z}$$

wherein

Me^{I} is at least one divalent cation selected from the

group consisting of Ca, Sr, Ba, Eu, Be, Mg, and Zn, or at least one trivalent cation selected from group III metals of the Periodic Table, for example, Sc, Y, and La and Gd, Sm, Dy, and Pr,

Me^{II} is at least one monovalent cation selected from the group consisting of alkali metals,

X is an ion selected from Cl and F for charge balancing,

$0 \leq x \leq 4$,

$0 \leq y \leq 4$,

$0 \leq m \leq 4$,

$0 \leq a \leq 1$, and

$0 < z \leq 0.5$,

Mn is manganese with a valence of 2 to 4 and incorporated into the lattice, and

Ti is titanium that may be completely or partially replaced with Zr, Hf, Si, or Ge, and may be partially replaced with B (boron), Al (aluminum), Ga (gallium), In (indium), P, Nb, Ta, or V, provided that, in this case, in the cation partial lattice, there is a proper charge balance or a halogen is further incorporated.

6. A phosphor for LED for converting ultraviolet or blue light emitted from the light emitting element according to claim 1 to a visible white radiation having a very high level of color rendering properties, characterized by comprising a red light emitting manganese(IV)-activated silicate-germanate or yellow-orange light emitting manganese(II)-activated silicate-germanate represented by general formula

$Me^{I}_{x}Me^{II}_{y}Ge_{1-a}O_{z}X_{m}:Mn_{w}$

wherein

Me^{I} is at least one divalent or/and trivalent metal selected from group II or III metals of the Periodic Table and/or at least one lanthanide ion selected from the group consisting of Eu, Pr, Sm, Gd, and Dy,

Me^{II} is at least one monovalent cation,

X is at least one anion selected from Cl and F elements,

$0 < w \leq 0.5$,

$0 < x \leq 28$,

$0 \leq y \leq 14$,

$0 \leq m \leq 20$,

$0 \leq a < 1$,

$0 < z \leq 48$,

and Ge may be completely or partially replaced with Si, Zr, or Ti, and/or may be partially replaced with B, Al, or Ga, and further may be replaced with P, V, Nb, Ta, W, or Mo.

7. A phosphor for converting ultraviolet or blue light emitted from the light emitting element according to claim 1 to a visible white radiation having a very high level of color rendering properties, characterized by comprising a europium-activated silicate-germanate capable of emitting a light among lights ranging from orange light to orange-red light with a broadband light emitting spectrum at 588 to 610 nm.

8. A phosphor for converting ultraviolet or blue light emitted from the light emitting element according to claim 1 to

a visible white radiation having a very high level of color rendering properties, characterized by comprising a red light emitting manganese(IV)-activated aluminate or orange light emitting manganese(II)-activated aluminate having a simple spinel-type structure up to a hexagonal structure represented by general formula

$$Me^{I}_{x}Me^{II}_{y}Al_{m}O_{n}:Mn$$

wherein

Me^{I} is at least one element selected from group II or III metals of the Periodic Table and/or at least one lanthanide ion selected from the group consisting of Eu, Pr, Sm, Gd, Dy, and Ce,

Me^{II} is at least one monovalent cation,

$0 \leq x \leq 8$,

$0 \leq y \leq 4$,

$0 < m \leq 16$,

$0 < n \leq 27$,

$0 < z \leq 0.5$, and

Al may be completely or partially replaced with B and/or Ga and/or may be partially replaced with P, V, Nb, Ta, Si, Ge, W, or Mo.

9. A phosphor for converting ultraviolet or blue light emitted from the light emitting element according to any one of claims 1, 6 and 8 to a visible white radiation having a very high level of color rendering properties, characterized in that a europium-manganese double activated phosphor is contained and that light, emitted from a manganese(II) ion, in a color among

colors ranging from yellow to red colors as either a separate emission band or a shoulder in low wavelength fusion of primary light emission is sensitized with a primary activator in which the emission band overlaps with at least one characteristic excitation band of manganese(II) and emission of light from Eu is produced in a blue to green spectrum region.

10. A phosphor for converting ultraviolet or blue light emitted from the light emitting element according to claim 1 or 9 to a visible white radiation having a very high level of color rendering properties, characterized by comprising a borate-silicate-phosphate which has been activated by europium and manganese and is represented by general formula

$$Me^{I}_{x}Me^{II}_{y}(B,Si,P)_{a}O_{n}X_{m}:Eu,Mn$$

wherein

Me^{I} is at least one element selected from group II and/or group III metals of the Periodic Table and/or at least one lanthanide ion selected from the group consisting of Eu, Pr, Sm, Gd, Dy, and Ce,

Me^{II} is at least one monovalent cation,

X is Cl, F, or Br,

$0 \leq x \leq 10$,

$0 \leq y \leq 12$,

$0 < a \leq 6$,

$0 < n \leq 24$,

$0 \leq m \leq 16$, and

B may be completely or partially replaced with P, Si, Ga, or Al and may be partially replaced with V, Nb, Ta, Ge, W, or

22 Mo.

11. A phosphor for converting ultraviolet or blue light emitted from the light emitting element according to any one of claims 1 to 10 to a visible white radiation having a very high level of color rendering properties, characterized in that white light having color rendering Ia and a color rendering index Ra > 90 is produced by a combination of a radiation emitted from the phosphor with a primary radiation emitted from a light emitting element capable of constituting a semiconductor element or a gas discharge lamp and, thus, this element can be used as a background illumination device and in lighting in a living space and furnishings, in photography and microscopic examination, in medical technology, and in lighting technology in museums and any place where a very authentic color rendering is important.

12. A phosphor for converting ultraviolet or blue light emitted from the light emitting element according to any one of claims 1 to 11 to a visible white radiation having a very high level of color rendering properties, characterized in that said phosphor is applied, either solely or as a mixture of other phosphor, as a layer in a light emitting element and white light with color rendering Ia is produced by a combination of a primary radiation emitted from said light emitting element with a radiation emitted from the layer of the phosphor.

13. A phosphor for converting ultraviolet or blue light

emitted from the light emitting element according to any one of claims 1 to 12 to a visible white radiation having a very high level of color rendering properties, characterized in that said light emitting element used is LED for emitting a primary radiation in an ultraviolet spectrum region with more than 300 nm or a violet or blue spectrum region with more than 380 nm.

14. An optical device comprising a wavelength converting part, said wavelength converting part comprising a phosphor capable of emitting light excited based on light emitted from an LED element, characterized in that

said wavelength converting part comprises a light emitting component prepared from a solid system of an alkaline earth metal antimonate and a system derived from the solid system exhibiting intrinsic photoemission, such as a fluoroantimonate, a light emitting component prepared from a manganese(IV)-activated antimonate, a titanate, silicate-germanate, and an aluminate, a light emitting component prepared from a europium-activated silicate-germanate or from a system containing a sensitizer selected from a group consisting of Eu(II) and Mn(II) as a secondary activator and having an orange color, an orange-red color, a red color, or a dark red color in the spectrum range over 600 nm, or a phosphor with a different emission band.

15. An optical device characterized by comprising

an LED element,

a power feeding part for mounting said LED element

thereon and feeding power to said LED element,

a light transparent sealing part for sealing said LED element and said power feeding part integrally with each other, and

a wavelength converting part for emitting light upon excitation based on light emitted from said LED element, said wavelength converting part comprising a light emitting component prepared from a solid system of an alkaline earth metal antimonate and a system derived from the solid system exhibiting intrinsic photoemission, such as a fluoroantimonate, a light emitting component prepared from a manganese(IV)-activated antimonate, a titanate, silicate-germanate, and an aluminate, a light emitting component prepared from a europium-activated silicate-germanate or from a system containing a sensitizer selected from a group consisting of Eu(II) and Mn(II) as a secondary activator and having an orange color, an orange-red color, a red color, or a dark red color in the spectrum range over 600 nm, or a phosphor with a different emission band.

16. An optical device characterized by comprising

an LED lamp,

a light guiding part for guiding light emitted from said LED lamp,

a wavelength converting part for emitting light upon excitation based on light guided through said light guiding part, said wavelength converting part comprising a light emitting component prepared from a solid system of an alkaline

earth metal antimonate and a system derived from the solid system exhibiting intrinsic photoemission, such as a fluoroantimonate, a light emitting component prepared from a manganese(IV)-activated antimonate, a titanate, silicate-germanate, and an aluminate, a light emitting component prepared from a europium-activated silicate-germanate or from a system containing a sensitizer selected from a group consisting of Eu(II) and Mn(II) as a secondary activator and having an orange color, an orange-red color, a red color, or a dark red color in the spectrum range over 600 nm, or a phosphor with a different emission band, and

a part to be lighted based on light emitted through said wavelength converting part.

17. An optical device according to any one of claims 14 to 16, characterized in that

said wavelength converting part comprises a phosphor, said phosphor comprising a light emitting alkaline earth metal antimonate represented by general formula

$Me^{I}_{x}Me^{II}_{y}Sb_{a}O_{b}X_{c}$

wherein

Me^{I} is at least one element selected from the group consisting of calcium (Ca), strontium (Sr), barium (Ba), cadmium (Cd), zinc (Zn), beryllium (Be), magnesium (Mg), europium (Eu), manganese (Mn), scandium (Sc), yttrium (Y), lanthanum (La), samarium (Sm), praseodymium (Pr), dysprosium (Dy), and terbium (Tb),

Me^{II} is at least one element selected from the group

consisting of lithium (Li), sodium (Na), potassium (K), rubidium (Rb), and cesium (Cs),

X (uppercase letter) represents at least one element selected from the group consisting of fluorine (F), chlorine (Cl), and bromine (Br),

x (lowercase letter) = 0 (zero) to 8,

y = 0 to 4,

$0 < a < 16$,

$0 < b < 64$,

$0 \leq c \leq 4$,

and a part of antimony (Sb) may be replaced with vanadium (V), niobium (Nb), tantalum (Ta), phosphorus (P), arsenic (As), titanium (Ti), zirconium (Zr), hafnium (Hf), silicon (Si), germanium (Ge), molybdenum (Mo), or tungsten (W), or alternatively may contain a system derived from them, for example, a fluoroantimonate.

18. The optical device according to any one of claims 14 to 16, characterized in that said wavelength converting part comprises a phosphor comprising an alkaline earth metal antimonate which exhibits intrinsic photoemission and emits light in a red spectrum region with a maximum emission wavelength of about 600 to 670 nm.

19. The optical device according to any one of claims 14 to 16, characterized in that said wavelength converting part comprises a phosphor comprising a light emitting manganese(IV)-activated antimonate which exhibits an emission band in a deep

red spectrum region with about 600 to 700 nm or a narrow structured light emission with about 650 to 660 nm.

20. The optical device according to any one of claims 14 to 16, characterized in that said wavelength converting part comprises a phosphor comprising a manganese(IV)-activated titanate represented by general formula

$$Me^{I}_{x}Me^{II}_{y}Ti_{1-a}O_{4}X_{m}:Mn_{z}$$

wherein

Me^{I} is at least one divalent cation selected from the group consisting of Ca, Sr, Ba, Eu, Be, Mg, and Zn, or at least one trivalent cation selected from group III metals of the Periodic Table, for example, Sc, Y, and La and Gd, Sm, Dy, and Pr,

Me^{II} is at least one monovalent cation selected from the group consisting of alkali metals,

X is an ion selected from Cl and F for charge balancing,

$0 \leq x \leq 4$,

$0 \leq y \leq 4$,

$0 \leq m \leq 4$,

$0 \leq a \leq 1$, and

$0 \leq z \leq 0.5$,

Mn is manganese with a valence of 2 to 4 and incorporated into the lattice, and

Ti is titanium that may be completely or partially replaced with Zr, Hf, Si, or Ge, and may be partially replaced with B (boron), Al (aluminum), Ga (gallium), In (indium), P, Nb, Ta, or V, provided that, in this case, in the cation partial

lattice, there is a proper charge balance or a halogen is further incorporated.

21. The optical device according to any one of claims 14 to 16, characterized in that said wavelength converting part comprises a phosphor comprising a red light emitting manganese(IV)-activated silicate-germanate or yellow-orange light emitting manganese(II)-activated silicate-germanate represented by general formula

$$Me^{I}_{x}Me^{II}_{y}Ge_{1-a}O_{z}X_{m}:Mn_{w}$$

wherein

Me^{I} is at least one divalent or/and trivalent metal selected from group II or III metals of the Periodic Table and/or at least one lanthanide ion selected from the group consisting of Eu, Pr, Sm, Gd, and Dy,

Me^{II} is at least one monovalent cation,

X is at least one anion selected from Cl and F elements,

$0 \leq w \leq 0.5$,

$0 < x \leq 28$,

$0 \leq y \leq 14$,

$0 \leq m \leq 20$,

$0 \leq a < 1$,

$0 < z \leq 48$,

and Ge may be completely or partially replaced with Si, Zr, or Ti, and/or may be partially replaced with B, Al, or Ga, and further may be replaced with P, V, Nb, Ta, W, or Mo.

22. The optical device according to any one of claims 14

to 16, characterized in that said wavelength converting part comprises a phosphor comprising a europium-activated silicate-germanate capable of emitting a light among lights ranging from orange light to orange-red light with a broadband light emitting spectrum at 588 to 610 nm.

23. The optical device according to any one of claims 14 to 16, characterized in that said wavelength converting part comprises a phosphor comprising a red light emitting manganese(IV)-activated aluminate or orange light emitting manganese(II)-activated aluminate having a simple spinel-type structure up to a hexagonal structure represented by general formula

$$Me^{I}_{x}Me^{II}_{y}Al_{m}O_{n}:Mn$$

wherein

Me^{I} is at least one element selected from group II or III metals of the Periodic Table and/or at least one lanthanide ion selected from the group consisting of Eu, Pr, Sm, Gd, Dy, and Ce,

Me^{II} is at least one monovalent cation,

$0 \leq x \leq 8$,

$0 \leq y \leq 4$,

$0 < m \leq 16$,

$0 < n \leq 27$,

$0 < z \leq 0.5$,

Al may be completely or partially replaced with B and/or Ga and/or may be partially replaced with P, V, Nb, Ta, Si, Ge, W, or Mo.

24. The optical device according to any one of claims 14 to 16, characterized in that said wavelength converting part comprises a europium-manganese double activated phosphor and that light, emitted from a manganese(II) ion, in a color among colors ranging from yellow to red colors as either a separate emission band or a shoulder in low wavelength fusion of primary light emission is sensitized with a primary activator in which the emission band overlaps with at least one characteristic excitation band of manganese(II) and emission of light from Eu is produced in a blue to green spectrum region.

25. The optical device according to any one of claims 14 to 16, characterized in that said wavelength converting part comprises a phosphor comprising a borate-silicate-phosphate which has been activated by europium and manganese and is represented by general formula

$$Me^{I}_{x}Me^{II}_{y}(B,Si,P)_{a}O_{n}X_{m}:Eu,Mn$$

wherein

Me^{I} is at least one element selected from group II and/or group III metals of the Periodic Table and/or at least one lanthanide ion selected from the group consisting of Eu, Pr, Sm, Gd, Dy, and Ce,

Me^{II} is at least one monovalent cation,

X is Cl, F, or Br,

$0 \leq x \leq 10$,

$0 \leq y \leq 12$,

$0 < a \leq 6$,

$0 < n \leq 24$,

$0 \leq m \leq 16$, and

B may be completely or partially replaced with P, Si, Ga, or Al and may be partially replaced with V, Nb, Ta, Ge, W, or Mo.

26. The optical device according to claim 15, characterized in that said wavelength converting part is included in said light transparent sealing resin for sealing said LED element.

27 The optical device according to claim 15, characterized in that said phosphor is a thin-film phosphor layer that is sealed with said light transparent glass.

28. The optical device according to claim 26, characterized in that said phosphor layer is planar.

29. The optical device according to claim 15, characterized in that said wavelength converting part is provided on a surface of the sealing resin having an optical shape that radiates light emitted from said LED element in a desired lighting area.

30. The optical device according to any one of claims 14 to 16, characterized in that said wavelength converting part is excited upon exposure to blue light and/or ultraviolet light with wavelengths ranging from 300 nm to 500 nm.